Geometry effects on cooling in a standing wave cylindrical thermoacousic resonator

Abstract

Numerous reports have established the refrigeration applications of thermoacoustic cooling without compressors and refrigerants. Significant cooling effects can be obtained in a thermoacoustic resonator fitted with a heat exchanging stack and operated at resonance frequency. Past studies, however, have hardly referred to the fundamental relationship between resonant frequency and the resonator geometry. This paper reports the thermoacoustic cooling effects at resonance obtained by changing the diameter of the resonator while holding the length constant and vice versa. Experiments were completed at atmospheric pressure with air as the working fluid using a number of pvc tubes having parallel plate stack from Mylar. The temperature difference measured across the stack showed that a volume increase in the working fluid in general increases the temperature gradient for the quarter-and half-wavelength resonators. Doubling the diameter from 30 mm to 60 mm produced the highest temperature difference due to the greater number of stack plates resulting in a higher overall thermoacaoustic cooling. Increasing the resonator length only produced a small increase in temperature gradient since the resonant frequency at operation is only slightly changed. Investigation on the aspect ratio exhibits no influence on the temperature difference across the stack. This study have shown that the resonator length and diameter do affect the temperature difference across the thermoacoustic stack, and further research should be done to consider the contribution of the stack mass on the overall desired thermoacoustic cooling.